Chapter 97

Alternative Approaches to Auction Trading by Consortia in Multi Agent Systems:
A Comparative Study

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ABSTRACT

Agent-based auction trading is important in e-Procurement as a part of the supply chain management activity of procurement via the Internet. Participating buyers and sellers are intelligent agents tasked with finding matches with required or offered quantities for best performance. Formation of consortiums offers opportunities in matching trade volumes, but in the real world, there are difficulties in optimizing consortium formation due to lack of perfect information and the dynamic character of the information. Heuristic methods are often the only solution. This chapter shows the impact and capabilities of alternate heuristic models, and compares their performances in auction trading.

INTRODUCTION

Auction trading over the Internet has become a standard procedure for the procurement and electronic acquisition of products and services in a process known otherwise as e-Procurement. Auction trading in its traditional form has long been considered an important part of managing the supply chain in terms of keeping the cost down and the volume high. The Internet made the process faster and more effective reducing the cost and increasing the efficiency. Using the Internet intelligent agents can become the trading entities, both buyers and sellers. Agent based auction trading takes the trading process one step further to reduce cost and increase efficiency. The e-Procurement

mechanism is enhanced by the procurement of larger volumes at more attractive prices. This has made the e-Procurement mechanism the primary selling mechanism for tier one suppliers giving them the selling advantage of enabling them to move the largest possible volume at the best price. It is equally an advantage for large buyers allowing them access to a large volume of supply at competitive prices. In recognition of the supply chain benefits of the e-trade environment, the European Union has made it mandated for many transactions.

The environment of agent-based auction trading consists of online auctions between web-based buyer agents and web-based seller agents. The trading mechanism works best when there are many buyers and many sellers providing a competitive marketplace and volume economies. The challenge of high performance in a complex and competitive market is to match buyers and sellers. Typically, there are two parameters of a match, price and volume. Price may often be a concern for the feasibility of a trade, *i.e.* a buyer or seller will not trade above or below a certain price. A special type of purchase concerns MRO products used by manufacturing organizations, where MRO stands for "Manufacturing, Repair, and Operations". Typically MRO products are not part of the finished goods that constitute the bulk of the revenue. MRO products may have prevailing market prices and matching prices is automatic. As a first step, we consider matching volumes alone, and compare matching approaches on the basis of trading volumes. The comparison may later be extended to matching in the two dimensions of price and quantity. The volume matching option is especially interesting because volume is subject to an individual agent's bid as a buyer, or offer as a seller. In a traditional trading environment, cooperation and consortium formation is the strategy used to match a larger volume by a collaborative combination of smaller volumes. The focus of this research is to compare alternate methods to replicate the cooperative process of

matching and volume generation when the trading entities are agents.

The proposed system studied here is a two-tier e-Procurement or auction trading environment, where the trading entities consist of multiple suppliers, or selling agents, and multiple buyers represented by buying agents. In a *forward auction*, a seller agent proposes a volume of trade and a buyer agent matches the volume, or a consortium of buyer agents, seek to match the seller's volume by a combination of their individual volumes. In a *reverse auction*, a buyer agent proposes a bid volume, and a seller agent matches the volume, or a consortium of seller agents, seek to match the buyer's volume by a combination of individual volumes. While the priority remains on direct matching as the most convenient for buyer and seller alike, cooperative trading has an enormous potential in increasing trading volumes and in reducing waiting times for matches, thereby increasing the efficiency of trading.

Agents working together in a community, making collaborative decisions in auction trading to achieve individual goals, form a *Multi-agent System* (MAS). The information on available trades is freely available to all involved trading agents, and the cooperative actions between them to form consortiums is as important as their decision-oriented actions in the selection and confirmation of the trades. Binbasioglu (1999) proposed an approach to identify a set of problem components to support the progress of understanding and structuring multi-agent software architecture to manage a supply chain for tactical as well as operational decisions. Fox *et al.* (2000) presents in his paper a solution to construct the software to manage the supply chain at tactical and operational levels using agent-based systems. Typically, agent-based systems utilize order acquisition agents, logistic agents, transportation agents, scheduling agents, resources agents, *etc.* Coordination of agent activity is an important aspect of the work done by groups of agents, for which a critical element is the availability of information. Nag (2008) shows a

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